Instructor:  Dr. Tracy Stepien  
Office:  317 Mathematics (MATH)  
Phone:  (520) 621-3832  
E-mail:  stepien@math.arizona.edu  
Web Site:  http://math.arizona.edu/~stepien/  
Office Hours:  
- Wednesdays 3pm–4pm and Thursdays 9am–10am, in my office: MATH 317  
- Fridays 12pm–1pm, in MATH 220 tutoring location  
- By appointment  

Lecture Time and Place:  Mondays, Wednesdays, and Fridays 2:00pm–2:50pm  
312 Modern Languages Building (M LNG)  


Course Description:  General theory of initial value problems, linear systems and phase portraits, linearization of nonlinear systems, stability and bifurcation theory, an introduction to chaotic dynamics.  

Prerequisites:  Linear algebra (MATH 215, 313, or 410) and ordinary differential equations (MATH 254 or 355).  

Course Web Site:  All course materials and information will be accessible through D2L:  
http://d2l.arizona.edu/.  
D2L will also serve as our course gradebook. Please verify the accuracy of all assignment and exam scores in a timely fashion.  

Communication:  It is the student’s responsibility to keep informed of any announcements, syllabus adjustments, or policy changes made during scheduled classes, by email, or through D2L. Students are required to use their official UA e-mail address for course-related communications with their instructor.  
For homework questions, we will be using Piazza (via link on the D2L page) for class discussion. The system is highly catered to getting you help fast and efficiently from classmates and myself. Rather than emailing questions to the teaching staff, post your questions on Piazza.  

Homework:  Written homework assignments showing all work with proper notation will be due weekly via electronic submission through Gradescope (instructions posted on the course D2L web site).  
**Late submissions will receive a point deduction of 10% per day late.** Note that late days are counted in 24-hour periods. For example, if the cutoff for on-time submission is 5pm, submitting between 5:00:01pm on the due date and 5pm the next day is one day late, and
so on. Every assignment has a hard deadline, usually 2 days past the original due date, and late submissions (penalty or not) are not accepted after the hard deadline.

The two lowest homework scores will be dropped at the end of the semester.

**Exams:** There will be one in-class midterm exam tentatively scheduled for

- Friday, March 1

and a final exam scheduled for

- Friday, May 3 from 1:00pm–3:00pm

in the regular classroom.

In general, there will be no make-up exams in the course. However, in complex and unusual circumstances which are beyond your control, a make-up exam may be given on a case-by-case basis. This will require providing a detailed account of the situation and supporting documents. The instructor must be notified as soon as possible, preferably before the exam is given with as much advanced notice as possible. Approval in these cases is at the sole discretion of the instructor and/or the dean of students.

There are no exam retakes or corrections, no lowest exam will be dropped, and there will be no extra credit assignments to erase the consequences of a bad exam score.

Check [http://www.registrar.arizona.edu/schedules/finals.htm](http://www.registrar.arizona.edu/schedules/finals.htm) for the final exam schedule for all classes. The University’s Final Exam regulations will be strictly followed: [http://www.registrar.arizona.edu/courses/final-examination-regulations-and-information/](http://www.registrar.arizona.edu/courses/final-examination-regulations-and-information/).

**Grades:** The semester grade will be computed based on:

- Final Exam: 40%
- Midterm Exam: 30%
- Homework: 30%

Your final course grade will be no lower than the following:

A: [90, 100]  B: [80, 90]  C: [70, 80]  D: [60, 70]  E: [0, 60]

Grades are based only on academic work and are calculated using the same criteria for all students. It is unethical to bring to your instructor’s attention the possible impact of your mathematics grade on your future plans, including graduation, scholarships, jobs, etc.

**Requests for Withdrawal (W) and Incomplete (I):** Must be made in accordance with University policy:

- [http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal](http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal)
- [http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete](http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete)

**Attendance:** Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is expected at all lectures. Students may be administratively dropped from the course for lack of attendance; however, students should be aware that nonattendance does not automatically result in being dropped from the course.

The UA’s policy regarding absences for any sincerely held religious belief, observance, or practice will be accommodated where reasonable; see: [http://policy.arizona.edu/human-resources/religious-accommodation-policy/](http://policy.arizona.edu/human-resources/religious-accommodation-policy/).

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored; see: [http://deanofstudents.arizona.edu/absences/](http://deanofstudents.arizona.edu/absences/).

If you are experiencing unexpected barriers to your success in your courses, the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office is located in the Robert L. Nugent Building, room 100, or call 520-621-7057.

**Classroom Behavior:** To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (texting, chatting, reading a newspaper, making phone calls, web surfing, taking photos, etc.).

The use of personal electronics such as laptops, tablets, cell phones, and other such mobile devices is distracting to the other students and the instructor. Their use can degrade the learning environment. Therefore, students are not permitted to use these devices during the class period.

**Accessibility and Accommodations:** At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, [http://drc.arizona.edu/](http://drc.arizona.edu/)) to establish reasonable accommodations.

**University Policies and Additional Resources for Students:**

- UA Academic Policies and Procedures are available at: [http://catalog.arizona.edu/policies/](http://catalog.arizona.edu/policies/).
- The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself; see: [http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students/](http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students/).

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog; see: [http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity/](http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity/).

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor’s express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or
buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

- The University is committed to creating and maintaining an environment free of discrimination; see http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy/.

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.


- Student Assistance and Advocacy information is available at: http://deanofstudents.arizona.edu/student-assistance/students/student-assistance/.

**Important Note:** Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

**Tentative Lecture Schedule:** This schedule is approximate as to topics. Coverage of topics may be affected by weather cancellations or how rapidly we cover the material. Additional topics may be covered if time permits.

<table>
<thead>
<tr>
<th>Week</th>
<th>Book Sections Covered</th>
<th>Observations</th>
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<tbody>
<tr>
<td>1. Jan.9–13</td>
<td>Review of ODEs. One-dimensional flows. §2.1–2.4</td>
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<td>3. Jan.21–27</td>
<td>Normal forms. Transcritical and pitchfork bifurcations. §3.2–3.5</td>
<td>Jan. 21: No Classes (Martin Luther King, Jr. Day)</td>
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<td>Jan. 22: Last day to drop with deletion from record</td>
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<td>4. Jan.28–Feb.3</td>
<td>Imperfect bifurcations. Flows on the circle. §3.6, 4.1–4.5</td>
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<tr>
<td>5. Feb.4–10</td>
<td>Two-dimensional flows. Linear systems. Phase portraits. §5.1–5.2, 6.1</td>
<td>Feb. 6: Last day to file for GRO</td>
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<td>6. Feb.11–17</td>
<td>Fixed points and linearization. Conservative and reversible systems. §6.2–6.7</td>
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<td>7. Feb.18–24</td>
<td>Index theory. Limit cycles. §6.8, 7.1–7.2</td>
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<td>9. Mar.4–10</td>
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<td>Mar. 4–8: No Classes (Spring Break)</td>
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<tr>
<td>10. Mar.11–17</td>
<td>Weakly nonlinear oscillators and perturbation theory. §7.6</td>
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<tr>
<td>Date</td>
<td>Topic</td>
<td>Notes</td>
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<td>11. Mar.18–24</td>
<td>Bifurcations in two dimensions. Hopf bifurcations. §8.1–8.2</td>
<td>Mar. 26: Last day to withdraw with W</td>
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<td>12. Mar.25–Mar.31</td>
<td>Global bifurcations. Applications. §8.3–8.5</td>
<td>Apr. 9: Last day to petition for late withdrawal to Dean of your college</td>
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<td>14. Apr.8–14</td>
<td>Synchronized chaos. One-dimensional maps. §9.6, 10.1</td>
<td>May 1: Last day of classes</td>
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<td>15. Apr.15–21</td>
<td>The logistic map: bifurcations and periodic windows. §10.3–10.4</td>
<td>May 3: Final Exam</td>
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<td>17. Apr.29–May 5</td>
<td>TBA</td>
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